This guidance is not a regulatory document and should be considered only informational and supplementary to the MPCA permits (such as the construction storm water general permit or MS4 permit) and local regulations.

PROTECTING WATER QUALITY IN URBAN AREAS

Best Management Practices for Dealing with Storm Water Runoff from Urban, Suburban and Developing Areas of Minnesota

Minnesota Pollution Control Agency

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ACKNOWLEGEMENTS

We thank all the agencies and individuals who contributed to the preparation of this manual. The first acknowledgement goes to the authors and contributors to the original edition of *Protecting Water Quality in Urban Areas*, which remains the standard of comparison for this type of document in Minnesota.

Many of the sediment- and erosion-control practices in this manual are based on best management practice (BMP) manuals or sediment-control handbooks from the states of Maryland, Virginia and North Carolina. Also, the State of Washington manual, *Storm Water Management Manual for the Puget Sound Basin*, was a primary source for information on a variety of subjects, but especially for chapter 7, Pollution Prevention.

The Metropolitan Washington Council of Governments (MWCG) was a primary source for summary information and design concepts related to treatment practices, as is the Center for Watershed Protection (CWP).

The *Engineering Field Manual* of the U. S. Department of Agriculture's Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, is a primary source for many design details found in this manual.

The Minnesota Department of Transportation (MnDOT) has been a primary source of local experience and information. The MnDOT *Standard Specifications* and *Manual of Practice* are sources that should be referenced for many design details. The Minnesota Department of Natural Resources (MDNR), Board of Water and Soil Resources (BWSR) and the Metropolitan Council of the Twin Cities (Met Council) where also significant sources of practical information.

In many cases, the recommended practices in this manual are based upon experience from organizations or individuals who have used them in Minnesota. These include local consultants, conservation districts, and individuals that have also been major contributors.

The names of the many individual contributors and reviewers who helped in the development of this manual are listed in Appendix II.

The U.S. Environmental Protection Agency (EPA) provided grants under section 319, which were the primary source of support and funding for this effort. The EPA was also the source of much technical data and analysis of information related to urban runoff issues.

PREFACE

This manual contains specific recommendations and criteria to be considered when implementing BMPs; however, it should not be confused with a design document. The manual does not contain complete detailed design information for all practices that are referenced.

The examples, recommendations and criteria highlight some of the major principles and notable points related to the practices based upon the best information available from a variety of sources. These sources should be used with caution since you must demonstrate the appropriateness and applicability of the practice to Minnesota and to your project in particular.

Some of the examples shown in this document represent projects which, under state or federal laws, may require permits or design by a registered design professional. This manual, the source references, and professional integrity should be seen as three legs providing a stable foundation for your project BMPs.

INTRODUCTION

Minnesota's waters — including its lakes, streams and ground water — are among our greatest resources. They provide recreation and livelihood for thousands of Minnesotans. They support our tourism industry, and are enjoyed by many visitors to our state. They are also used for industrial activities. However, these waters are fragile resources that are vulnerable to pollution from a wide variety of human activities. Water quality has become one of the more important environmental issues facing our state today.

In many areas of Minnesota, wetlands, lakes and streams are increasingly vulnerable to human impacts. Game-fish populations have declined because wetlands and shallow lakes have filled with sediment. Many waters have become unsuitable for swimming and fishing because of sediment and other pollutants. Moreover, there is increasing concern about the quality of Minnesota's ground water, which supplies drinking water for 75% of the state's population.

In the past, efforts to improve Minnesota's water have concentrated on controlling pollution from point sources — municipal or industrial facilities discharging to state waters. We have made good progress in controlling pollution in recent years, largely through the construction of new wastewater-treatment facilities for cities and industries. Nevertheless, Minnesota's lakes, streams and ground waters continue to be degraded by pollutants that are carried in runoff. These forms of pollution are called nonpoint-source pollution.

Nonpoint-source pollution has become a serious problem, affecting many of Minnesota's lakes and rivers. Table 1 compares the number of miles of rivers and acres of lakes in Minnesota that are affected by point- and nonpoint-source pollution.

Some people may believe that runoff from urban areas is "clean" or "natural" and that it does not harm water quality. This perception is understandable since many people do not realize that the volume and pollutant loading of runoff has been changed subtly over time. In addition, the amount of pollution from any one spot can be so small that it would be insignificant were it the only source. However, when all these small amounts are combined, they can cause serious water-quality problems. Current development practices have been shown to significantly impact watersheds by increasing runoff and pollutant loading with impervious surfaces covering as little as 10% of the watershed (Schueler, 1994b).

There are two main reasons why urbanization increases pollutant loads. First, the volume and rate of runoff are typically increased as an area is developed, providing a larger capacity to transport pollutants. The second reason is that some materials are typically more easily picked up in runoff as the vegetation is reduced and the impervious surface increases.

The discharge of storm water and snowmelt into wetlands can often have an adverse and sometimes devastating impact. Chapter 1 describes these hydrologic effects and the pollutants commonly associated with urban watersheds. Although many of the effects discussed here relate to surface water quality, it is important to note that ground water quality can also be adversely affected by urbanization.

Table 1 Statewide assessment of use attainability for Minnesota's waters

LAKES		
Statewide (1998): 1,984 lakes assessed representing 2,128,270 acres, of which 1,458,450 acres (69%) fully support swimmable use. **Lake Superior Basin**: 208 lakes assessed (80,059 acres), of which 60,881 acres (76%) fully support swimmable use. **Minnesota River Basin**: 176 lakes assessed (112,066 acres) of which 36,622 acres (33%) fully support swimmable use. **Red River Basin**: 142 lakes assessed (148,401acres) of which 130,632 acres (88%) fully support swimmable use.	Individual basins are assessed on a rotating basis; assessments are under way for remaining basins.	Swimmable use assessment is based on trophic status measurements. Use support categories are based on ecoregion-based P criteria and Carlson's TSI. In-lake phosphorus (P) is primary basis for assessment — chlorophyll-a or Secchi are used in absence of P. Lake assessment database is redone annually by downloading data from STORET.
STREAMS		
Statewide (1998): 62% of stream miles meet aquatic life use; 59% of stream miles meet swimmable (recreation) use. **Lake Superior Basin:** 62% of stream miles meet aquatic life use; 100% of stream miles meet swimmable use. **Minnesota River Basin:** 64% of stream miles meet aquatic life use; 20% of stream miles meet swimmable use. **Red River Basin:** 35% of stream miles meet aquatic life use; 34% of stream miles meet swimmable use.	Individual basins are assessed on a rotating basis; assessments are under way for remaining basins.	These assessments reflect the use of MPCA turbidity data, and more data from other sources, than previous assessments. These percentages are based on a consistent set of stream sites.

This manual is designed to help local government officials, urban planners, developers and citizens become aware of urban nonpoint pollution problems and to provide detailed information about management practices to help prevent and control nonpoint pollution. The first chapter of the manual describes the basic principles of water quality protection, types of nonpoint-source pollutants found in urban areas and their effects on water quality. Chapter 1 also provides a brief explanation of the hydrologic changes that occur with urbanization. Chapter 2 is a discussion of the use of BMPs in policy and practice.

Chapter 3 is designed to help the reader understand some basic aspects of comprehensive planning to control urban nonpoint-source pollutants. It provides a discussion of how careful site planning of new developments can help prevent pollution, and how stormwater-management strategies can be used to trap urban pollutants. Chapter 3 also describes a process for selecting BMPs to correct existing water-quality problems. Many of these principles and practices can also be used to control urban point-source pollution.

Chapters 4, 5, 6 and 7 discuss the BMPs that can be used to control urban nonpoint-source pollution. The BMPs are divided into three areas: stormwater-management practices (Chapter 4), ponds (Chapter 5), sediment- and erosion-control practices (Chapter 6) and housekeeping practices (Chapter 7). The discussion about each BMP contains information about target pollutants, effectiveness and planning considerations.

Chapter 8 discusses hydrologic and water quality models, as well as methods of determining runoff and peak discharge. This chapter also discusses the limitations of models and warnings on how models can be abused and misused.

Design recommendations are provided for the BMPs whenever it is desirable to highlight a specific aspect of the management practice because it is important to water quality, or to explain a standard used to judge the acceptability of a practice for water quality. Not all design details are provided. When this manual is silent on an issue, industry standards should be assumed to apply for the practice. These practices often involve a great deal of site-specific professional judgment. State laws may require that registered professionals design or approve design for some of the BMPs that affect public health or safety.

For some of the examples shown in this manual, state, federal or local laws require permits or that they be conducted by registered design professionals. No implementation of the practices in this manual should be allowed without an appropriate and demonstrated level of professional competence.

Our lakes, streams and ground water can be kept clean by understanding how urban activities can cause pollution, and by selecting appropriate BMPs. Used wisely, these practices can help protect Minnesota's waters for future generations.